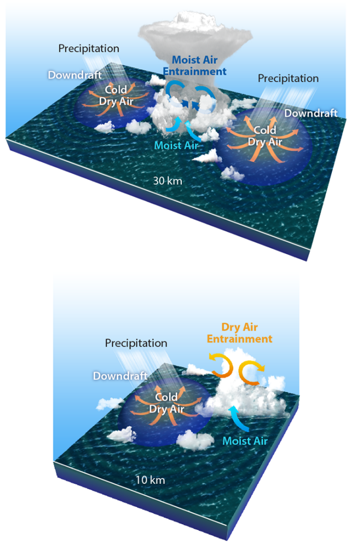
Intersecting Cold Pools: Convective Cloud Organization by Cold Pools over Tropical Ocean

Research Highlight

As rain drops descend to the surface, they can evaporate and cool the air. The cold air then spreads horizontally and forms pools at the surface that displace surrounding warm air. The dynamics of cold pools are an important mechanism of organizing convection. Researchers, including Department of Energy scientists at Pacific Northwest National Laboratory, investigated how convective clouds "self-organize" caused by precipitation-driven cold pools over the warm tropical Indian Ocean.

The data were gathered during the 2011 Atmospheric Radiation Measurement (ARM) Madden-Julian Oscillation (MJO) Investigation Experiment/Dynamics of the MJO (AMIE/DYNAMO) field campaign. Using a high-resolution regional model, the Weather Research and Forecasting model, they simulated clouds and precipitation during the transition from suppressed to active phases of the November 2011 MJO. They found that the simulated cold pool lifetimes, spatial extent, and thermodynamic properties agree well with the radar and ship-borne observations from the field campaign.

They found that intersecting cold pools last more than twice as long, are twice as large, 41% more intense, and 62% deeper than isolated cold pools. Consequently, intersecting cold pools trigger 73% more convection than do isolated ones. This is due to stronger outflows that enhance secondary updraft velocities by up to 45%. However, cold-pool-triggered convective clouds grow into deep convection not because of the stronger secondary updrafts at cloud base, but rather due to closer spacing between clouds and larger cloud clusters that form along the cold-pool boundaries when they intersect. The close spacing of large clouds moistens the local environment and reduces entrainment drying, increasing the probability that the clouds further develop into deep convection. Current climate model resolution is too coarse to resolve individual convective clouds and must rely on parameterizations. These findings represent a new approach to show the effects of cold pools on deep convective clouds.



The illustration shows the difference between cloud development from intersecting (top) and isolated (bottom) cold pools.

Reference(s)

Feng Z, S Hagos, AK Rowe, CD Burleyson, MN Martini, and SP de Szoeke. 2015. "Mechanisms of convective cloud organization by cold pools over tropical warm ocean during the AMIE/DYNAMO field campaign." Journal of Advances in Modeling Earth Systems, 7, doi:10.1002/2014MS000384.

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Cloud Life Cycle